

Planktothuria diaphana, gen. et sp. n.

By

J. D. F. Gilchrist, M.A., D.Sc., Ph.D.,

Professor of Zoology in the University of Cape Town.

With 4 Text-figures.

THE subject of the following notes is a transparent gelatinous organism, which was at first put aside with other plankton collections as some form of medusa. A subsequent examination, however, proved it to be a Holothurian with several features of special interest.

About a dozen in all were procured in a non-closing net used in deep water off the Cape of Good Hope, so that the depth at which they occurred is not known. Most of them were somewhat broken up on account of their delicate organisation, but a few were sufficiently perfect to allow of a fairly detailed examination.

The presence of a well-defined circle of tentacles, circular and radial canals could be readily made out, and were sufficient to indicate Holothurian affinities, the absence of external podia suggesting the family of the Molpadiidæ or Pelagothuriidæ. The fact, however, that the tentacles are supplied from the circular canal is an important feature, and one which renders the classification of the animal difficult.

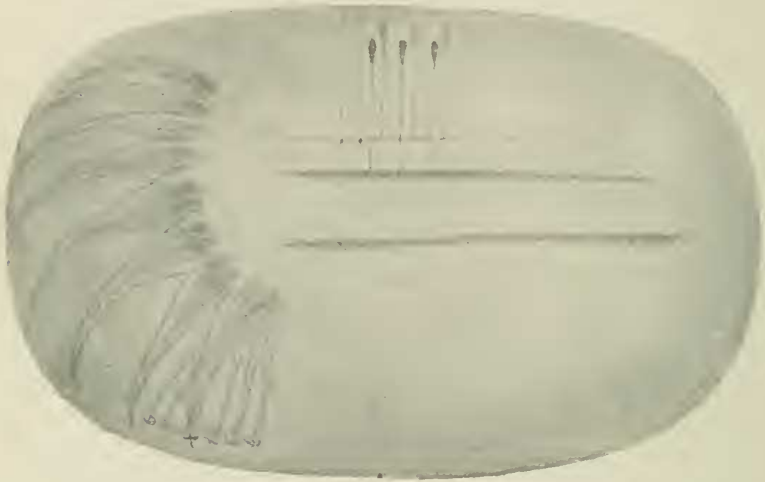
EXTERNAL CHARACTERS.

In the fresh state the whole body is transparent and buoyant. None were alive on being brought to the surface, and they settled slowly to the bottom of the vessel in which they

were placed. There was no marked coloration, the body being clear and glassy, like that of a medusa. In the preserved state the body is of a darker colour, and is surrounded by a thick jelly-like mass in which podia and tentacles may be seen embedded (Text-fig. 1).

The largest were about 40 mm. in length, and in one less than this mature ova were found, so that they do not repre-

TEXT-FIG. 1.



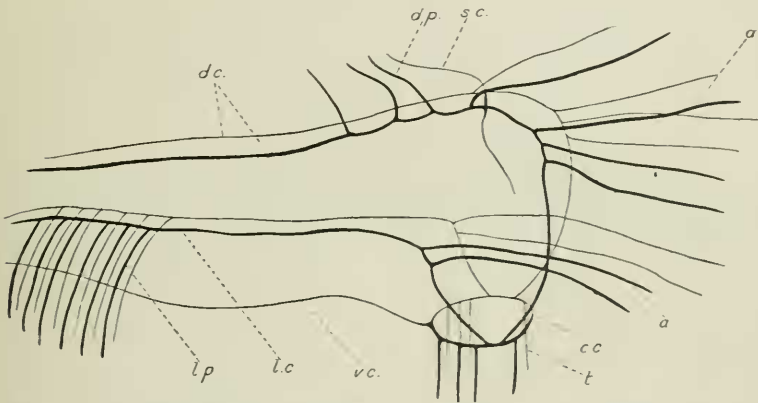
Planktothuria diaphana (dorso-lateral view), showing arms or anterior podia, tentacles, three pairs of dorsal podia, in front of which are the gonoduct and stone-canal.

sent young stages. The body is rounded and thick, its breadth being more than half its length. Probably in the living condition it is much more elongate. There is no differentiation of the upper and under surfaces, apart from the position of the mouth and tentacles. The mouth is small and directed more or less ventrally, the anus being terminal, and large and distinct in some individuals.

Podia.—The podia are all embedded in the thick gelatinous body-wall, and do not project beyond its surface, with perhaps the exceptions noted below. The ventral radial canal

has none, but both the two latero-ventrals and the dorsals have them. They are arranged in three distinct groups, which, however, are of mixed origin. Thus at the anterior end of the body they assume the form of a number of arms or tentacle-like structures, arranged in the form of a hood, partly surrounding the mouth-region. On the dorsal region they are delicate and thread-like, while at the posterior end of the body they are more pronounced, and project out laterally from the sides, being approximately at right angles to the body.

TEXT-FIG. 2.



Water-vascular system. *a.*, arms; *c.c.*, circular canal; *d.c.*, dorsal radial canal; *d.p.*, dorsal podia; *l.c.*, lateral radial canal; *l.p.*, lateral podia; *s.c.*, stone canal; *t.*, tentacles; *v.c.*, ventral radial canal.

The arms or oral podia are well developed and conspicuous structures, and consist of fine canals of the water-vascular system accompanied by muscular tissue, so that they assume the form of elongate arms, broad and closely appressed at their bases, and tapering off to a fine extremity in a wide curve or arch. They are somewhat flattened against each other near their bases, and, towards their middle, become narrower. The canal lies on the outer side of the muscular tissue, which, in transverse sections, assumes the form of a closed or convoluted layer of tissue with deeply staining

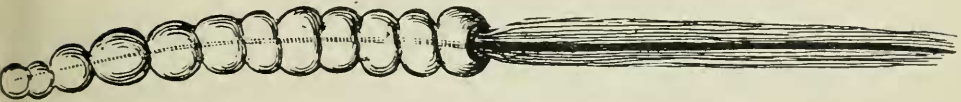
nuclei. The origin of the podia from the water-vascular system can readily be made out by a suitable preparation of the whole body. Text-fig. 2 is a camera lucida drawing of a specimen from which the viscera have been removed, and which has been stained sufficiently to show the water-vascular system. It is then seen that these anterior podia (Text-fig. 2, *a.*) arise, partly from the two lateral radials (*l.c.*), and partly from the two dorsal radials (*d.c.*) In this particular individual two arise from each of the lateral radials on each side, and four from each of the dorsal radials.

The dorsal podia (Text-fig 2, *d.p.*) are poorly provided with muscles, and appear only as delicate thread-like structures, apparently incapable of keeping in position unless supported by the surrounding tissue. They are situated in the anterior third of the body, and are usually six in number—three attached to each dorsal radial. In some small individuals only four were seen, and, in some of the larger, there were indications of additional podia posteriorly. That these dorsal podia, however, have some special functional significance seems to be indicated by the structure of the terminal portions. In the better-preserved specimens they are seen to end in swollen or enlarged structures, usually contracted into an elongate homogeneous mass, but when dissected out and examined microscopically are seen to be of the nature shown in Text-fig. 3. It is seen that the fine tubes and muscular strands of the main part somewhat suddenly become constricted, and then enlarge into a more solid part. This terminal portion is elongate (2.5 mm. in a large individual), and its surface is raised into a number of ring-like folds. Though in all cases this terminal part did not project beyond the surface of the body, it may be that in the living and fully-expanded condition it does so, and perhaps serves some sensory function, for it can hardly be an organ of respiration in view of its small size. Longitudinal sections show a well-defined epithelium, a central canal and muscular tissue, which occurs, however, on the posterior side only.

The lateral podia (Text-figs. 1, 2, *l.p.*) vary in number but are usually six to eight. They are confined to the posterior half of the latero-ventral radials. In structure and appearance they resemble those of the anterior end of the body. Proximally they are broad and flattened in a plane at right angles to the main axis of the body, but at their distal end they taper into a fine point which does not project beyond the surface of the body.

Tentacles.—These are well-developed structures, and their enlarged extremities form a conspicuous feature of the body, each of these being divided into two main branches, from which lateral branches arise (Text-fig. 4, *t.*). The tentacles vary in number and apparently increase in size and

TEXT-FIG. 3.



One of the dorsal podia, showing the modified terminal portion.

number with the age of the animal, 8 being found in the smallest and 16 in the largest.

The origin of these tentacles from the water-vascular system can readily be made out, both in the entire animal and in stained preparations. It was seen that they arose entirely from the circular canal. To make this important fact quite certain the ring-canal was dissected out, stained, and mounted whole (Text-fig. 4), and in another case was sectioned, and the direct connection between tentacles and canal confirmed. The point of origin of the tentacle from the circular canal has no definite or constant relation to that of the longitudinal canals. In the case figured two arise between the dorsal radials, three and six on each side of the ventral radial.

Stone-canal.—Slightly in front of the dorsal podia, and in the mid-dorsal region between the two radials, may be

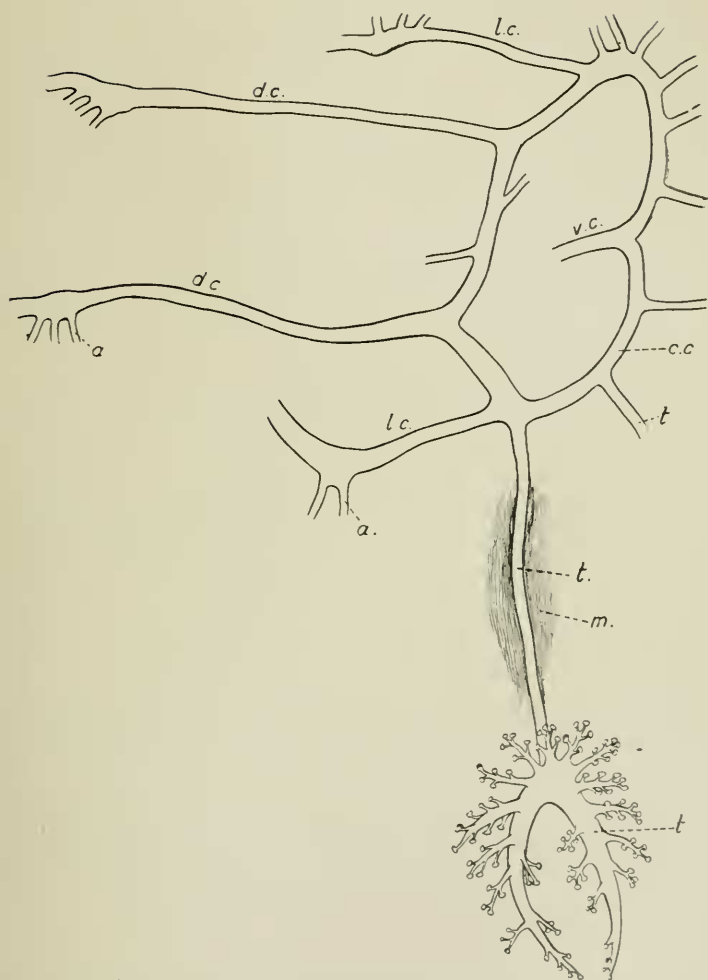
seen two slender tubes, not very different in appearance from the dorsal podia (Text-fig. 1). The posterior of these leads to the gonads, and that in front (Text-fig. 2, *s.c.*) to the circular canal, and is apparently the stone-canal. It opens by a single opening on the surface of the body, and is continued inwards as a fine tube till it passes the muscular layers, when it expands into a much thicker portion. No calcareous deposits were observed in any part of the stone-canal, the thicker portion appearing in sections as a simple tube with deeply staining walls, more developed on one side than on the other. The stone-canal and its swollen part are indicated in Text-fig. 2. The connection with the circular canal, though seen in dissections of large specimens, was not made out in this preparation, in which it has been broken off, and is, therefore, not indicated in the drawing.

Body-wall.—The body-wall consists mainly of a thick, gelatinous tissue, composed of elongate cells with deeply staining nuclei. It is similar in its nature to that found in some other deep-sea Holothurians, but is more developed, and of a looser and more transparent nature. Below it are the circular and longitudinal muscles of the body. The circular muscles are not well developed, and are interrupted by the longitudinal. The latter are double and are well developed. Retractor muscles were not observed.

Skeletal System.—The skeletal system is poorly developed. No calcareous deposits were found in the body-wall, either in stained or unstained preparations, but round the œsophagus were numerous minute-knobbed spheres, which were about $\cdot 0176$ mm. in diameter, this size being very constant. Effervescence occurred on the application of an acid, so that doubtless they represent all that remains of a calcareous ring.

Alimentary Tract.—The mouth is situated in the middle of a large peristome which faces somewhat ventrally; in some cases its plane is quite parallel to the long axis of the body. The mouth, therefore, is distinctly ventral in position. The alimentary tract is more or less injured, apparently by

TEXT-FIG. 4.



Anterior region of water-vascular system, showing circular canal (*c.c.*), from which are given off the two dorsal radial canals (*d.c.*), two lateral radial canals (*l.c.*), one ventral radial canal (*v.c.*), and eleven tentacles (*t.*), one of which is drawn in the fully-expanded condition; *a.*, arms; *m.*, muscle accompanying canal of tentacle.

the strong contraction of the longitudinal muscles; in one it has been forced out at the mouth, in another at the anus, and in others the body-wall has been ruptured. In one, however, it was observed that the median dorsal mesentery was attached to the intestine for about two-thirds of the length of the body. The course of the intestine is seen in some to be in the form of a double loop. The wall of the intestine is very thin when distended with food, and when not so distended shows in transverse sections numerous convolutions. There is no trace of a respiratory tree nor a Cuvierian organ, but the rectal portion of the intestine, in one or two cases, is distinctly enlarged and connected to the body-wall by muscular fibres. No diverticulum of this part was observed, but the walls were spongy and soft.

The food found in the alimentary tract consisted of greenish flocculent material, radiolarians, foraminifera, many diatoms and sponge spicules.

Gonads.—In a specimen 30 mm. from mouth to anus the ovaries, judging from the state of the ova, are well developed. They occur at the anterior part of the body, and are attached to the dorsal mesentery. They are in the form of a bilobed grape-like mass, in which the larger ova could be readily seen with the naked eye. The rounded mass is 4 mm. in diameter, and is divided into a right and left half, placed to the right and left of the dorsal mesentery. A short duct passes to the body-wall, which it penetrates, and is continued as a long, thin-walled, very transparent tube, leading through the gelatinous epidermis to the exterior. It passes through the body-wall immediately behind the stone-canal, and not far from the base of the nearest arm (Text-fig. 1).

In a smaller female, 26 mm. in length from mouth to anus, the ovaries were apparently mature, some of the larger ova being found detached in the body-cavity. These mature ova are well characterised. They measure 3 mm. in diameter, and are surrounded by a clear glassy envelope. In the egg itself occurs a large spherical globule, about 16 μ m. in diameter, resembling a large oil-globule. Besides this large globule

several other and much smaller oil-globules occur in groups.

HABITS.

The habits of the animal can only be a matter of conjecture. It is certainly not so obviously adapted to a pelagic mode of life as *Pelagothuria*, the only Holothurian hitherto known to be free swimming. It has been observed, however, as I have already noted elsewhere ('Marine Biological Report No. iii, Union of South Africa,' 1916, p. 46), that some of the Holothurians procured in deep water off the South African coasts have the power of swimming about freely in the water by an undulatory movement of the body, so that there is nothing new or improbable in the supposition that the form under consideration, which seems to be more adapted structurally for this mode of life, should be pelagic. Probably such deep-sea Holothurians do not bury themselves in the soft mud of the floor of the ocean, but flit more or less readily over its surface.

SYSTEMATIC POSITION.

The chief difficulty in placing these animals in any of the great groups of the Holothuroidea is the fact that the tentacles arise from the circular canal. This character, following Ludwig's classification, would remove them from most of the families of the Holothuroidea (*Actinopoda*) and bring them into the family of the *Synaptidæ* (*Paractinopoda*), from which, however, they must be separated, as this family has neither radial canals nor podia. It would seem also to indicate the necessity of a basis of classification of families of the Holothuroidea other than that proposed by Ludwig.

Apart from this character the animal seems to be nearest to the *Elpidiidae*, and may be placed provisionally in this group as a new genus, or otherwise in a new family, the *Planktothuriidae*.

SUMMARY.

1. A medusa-like Holothurian has been found off the South African coasts.
2. It is devoid of external podia.
3. Podia are found embedded in the thick gelatinous epidermis, and are arranged in three groups in the form of—
 - (1) Arms or oral podia forming a hood-like structure over the mouth, and supplied from the dorsal and ventro-lateral radial canals.
 - (2) Dorsal podia, which are slender and terminate in knobs.
 - (3) Lateral podia towards the posterior end of the body.
4. Tentacles are supplied by the circular canal.
5. The stone-canal is single, and opens to the exterior by a single opening.
6. Calcareous deposits do not appear to occur in any part of the body, except in the form of small knobbed spheres round the œsophagus.
7. Respiratory tree and Cuvierian organ absent.
8. Gonads in two grape-like masses, one on each side of the dorsal mesentery, and opening to the exterior by a long, slender duct. Mature ova .3 mm. in diameter, and provided with oil-globules.
9. It cannot be placed in any of the known groups of Holothurians, chiefly on account of the origin of the tentacles from the circular canal.